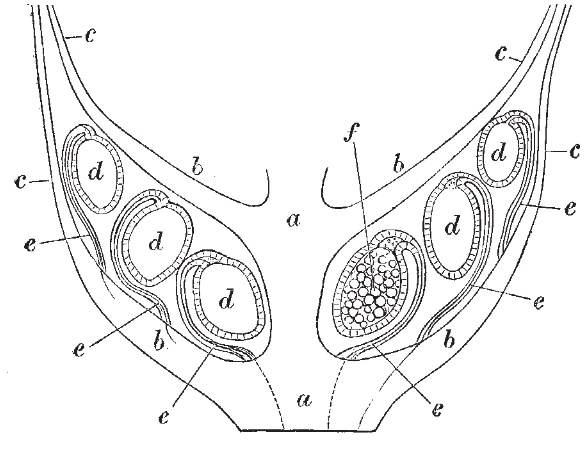
In 1890 I figured in my Memoir XVIII. (Phil. Trans. 1890) a transverse section of what was obviously a stem of *Bowmanites Dawsoni*, in which the primary triangular axis of the strobilus was invested by a thick zone of the secondary xylem. So far as the arrangement of its tissues is concerned this stem is constructed on exactly the same plan as appears in M. Renault's and my own Sphenophylla. In describing it I further said, "We must unite Sphenophyllum with some forms of Asterophyllites in the same genus. It is equally clear that Bowmanites, though its peculiar fructification demonstrates that it constitutes a perfectly distinct genus, has strongly marked features of affinity in the structure of its stem to the Sphenophylloid type."

The above reference to differences between the fructification of Bowmanites and of Sphenophyllum were based upon the minute description of the fruits of the latter plant, published by M. Renault ("Etudes sur le Terrain Houiller de Commentry," pp. 481-2). Those descriptions differ widely from what exists in my Bowmanites, but M. Renault distinctly identifies them with the fructification of Sphenophyllum. I obtained additional and important specimens of Bowmanites in 1890, which threw much new light upon its organization, and which were recorded in my Memoir XVIII. (Phil. Trans. 1891).

In July last an important communication was laid before the Academy of Sciences by my friend M. Zeiller, the distinguished director of the Superior National School of Mines at Paris. In it he records his identification of a fructification of a Sphenophyllum of the type of *S. pusillum* of Sternberg and *S. erosum* of Lindley and Hutton, with my *Bowmanites Dawsoni*. If this determination is correct, and I see no reason for doubting that it is so, we now have some more definite facts than we have hitherto possessed, guiding us alike in identifying the true fructification of Sphenophyllum and in determining its position in the vegetable kingdom.

Before explaining M. Zeiller's observations more in detail, a few words explanatory of the structure of Bowmanites will make M. Zeiller's views more intelligible to the reader.

The accompanying diagram represents two nodes and one internode from a vertical section of this fruit, with the sporangia and three sporangiophores *in situ*.



So far as external contours are concerned, it is undistinguishable from many of the true Calamarian forms of fructification. It is only when cut into sections that its characteristics can be discovered. Its central axis (*a*) has nodes (*b*) at short and regular intervals, and at each node is a verticil of from 16 to 20 sporophylles or fertile bracts (*c*). At their basal portions these bracts are coalesced into a lenticular disk (*d*), from the margin of which the thinner and narrowing bracts extend upwards, overlapping from two to three internodes. From the upper surface of the disk numerous slender sporangiophores (*e*) spring, each one proceeding upwards and outwards, to become attached to the *upper or distal* extremity of a large oval sporangium (*f*). Each of these sporangiophores has running through it a small bundle of barred tracheids, which terminate at the point of attachment to the sporangium. Each tracheal bundle is a prolongation of one of a circle of similar ones that ascend from the central axis into the disks. These fructifications, besides being manifestly eusporangiate, are extremely characteristic of the plant, nothing identical with them having been observed by any of the authors who have investigated the Carboniferous strobili. After these illustrations I will allow M. Zeiller to explain his views in his own words. After referring to the details given in my Memoir XVIII., M. Zeiller says:—

"L'aspect de ces sporanges, ainsi attachés au bout de ces pédicelles recourbés, est exactement, à part les dimensions moindres, celui de sporocarpes de *Marsilea*. L'analogie parait du reste n'être pas purement superficielle; M. Williamson a reconnu en effet, dans le pédicelle de chaque sporange, un cordon vasculaire bien caractérisé, qui prouve qu'on n'a pas affaire là à une simple formation épidermique, comme pour les sporanges de Fougères ou de Lycopodinées. Il faut, à ce qu'il semble, regarder ces pédicelles comme représentant des lobes ventraux des bractées, analogues au lobe fertile des frondes d'Ophioglossées, ou à ceux des Marsiliacées; seulement ils portent à leur extrémité non pas une série de sporanges comme chez les premières, ou plusieurs sores comme chez ces dernières, mais un sporange unique à paroi formée d'une seule assise de cellules."

"De cette constitution des épis du *Sphen. cuneifolium*[1] il report que, si les Sphenophyllum rappellent les Lycopodinées par la structure de leur axe, ils s'en éloignent notablement par la disposition toute spéciale de leur appareil fructificateur, qui tend à les rapprocher plutôt des Rhizocarpées, et qu'ils doivent donc bien décidément être considéré comme formant une classe distincte parmi les Cryptogames vasculaires."[2] Agreeing thoroughly with these conclusions further comments are needless. WM. CRAWFORD WILLIAMSON.

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## DENDRITIC FORMS.

THE curious appearances presented by certain native specimens of silica have been observed for so long, that it is somewhat surprising that so little is known about their real constitution and mode of formation.

Rock-crystal is frequently found to contain bubbles of liquid, usually either water, carbon dioxide, or petroleum, or crystals, such as scales of mica, forming aventurine, and fibres, such as asbestos, forming cat's-eye. More rarely, however, forms of apparently vegetable origin are seen; one of the most remarkable specimens is a prolate spheroid, about five inches long and four inches across, cut from a clear colourless rock-crystal, in which are embedded numerous fragments about the size of a large pea, presenting the exact appearance of club-moss.

Agate is frequently found with distinct coloured layers, either flat or distorted, and usually milk-white, red, brown, or black. It is then known as onyx.

More rarely, agates are found with markings like moss or foliage distributed through them; they are then known as moss-agates, or Mocha stones.

In 1814, Dr. J. MacCulloch described some cryptogamic forms in the agates of Dunglas (Geological Trans., ii.,

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[1] The species of Sphenophyllum to which M. Zeiller's strobili were attached.

[2] *Comptes Rendus des Séances de l'Académie des Sciences*, Paris, July 11, 1892.

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iv., 398). It is stated that the Earl of Powys possesses an onyx containing the chrysalis of a moth.

It seems to be generally assumed, without any strong evidence, that rock-crystal and agate have been formed from solution in water, possibly superheated, and that in such cases as those mentioned above, various crystalline or fibrous minerals and low forms of plant life have been inclosed during the process of solidification.

Though this explanation is very possibly true in many cases, it does not account for all the appearances seen in moss-agates; and another possible mode of formation may be suggested by a brief account of some experiments made more than twenty years ago.

Ordinary crystals of ferrous sulphate dissolve readily in cold water; but if they are placed in a dilute solution of an alkaline silicate, an entirely new series of phenomena are produced, which were first described by J. D. Heaton, M.D., in a paper "On certain Simulations of Vegetable Growths by Mineral Substances" (Brit. Assoc. Report, 1867, p. 83). On immersing crystals of ferrous sulphate in a solution of sodium silicate of the density 1·065, very beautiful arborizations will soon begin to shoot perpendicularly upwards, attaining the height of three or four inches in a few hours. In a weaker solution roots can be caused to shoot downwards from a suspended crystal. The fibres contain silica and iron (less the weaker the solution); they are brittle, and more dense than the liquid in which they are formed. Examined by the microscope, the ultimate ramifications are cylindrical, tapering tubes, the walls of which are granular, showing no sign of crystallization. The roots are more abrupt and occasionally club-shaped in their terminations. The growth is interstitial like that of organized living tissue. "Supposing such purely mineral substances to have been formed in by-gone geological eras, and to have been accidentally fossilized in some primary or other ancient rock, they would very probably, when discovered by recent investigation, be pronounced to be an evidence of organized beings having existed contemporaneously with the formation of such rock."

In the following year a similar observation was made by Prof. W. C. Roberts-Austen (J. C. S., 1868, xxi., 274). A solution containing 4·9 per cent. of silica, when allowed to gelatinize, and dried for two days over sulphuric acid, left a solid residue similar to opal from Zimapan, but containing 21·4 per cent. of water. All the specimens of jelly dried in air contained dendritic forms, varying in size from 0·2 to 0·5 mm. When magnified 90 times they appeared as radiating fibres; when the power was increased to 700 times linear, each fibre resolved itself into a series of elongated beaded cells with clusters of circular cells at intervals. Mr. Slack indicated their remarkable analogy to common blue mould or mildew. The cells appeared to be hollow, and did not blacken with sulphuric acid.

A few years later I repeated Dr. Heaton's experiments, and made some additional ones, a brief account of which may induce some one with better means at his disposal to investigate an interesting and somewhat neglected subject.

If a crystal of copper sulphate be suspended in a solution of potassium silicate, which has been carefully neutralized and has a density of 1·065, in the course of a few minutes a hollow green column will be seen to run down from the crystal to the bottom of the beaker. Sodium silicate may be used instead of potassium silicate, but the appearance and rapidity of the growth is somewhat changed. The solution may be neutralized with hydrogen sulphate, chloride, or acetate, but hydrogen fluoride appears to prevent all growth. If the solution has a density less than 1·06, no growth occurs, and the crystals generally dissolve; the weaker the solution down to this limit the more rapid the growth. If the solution be stronger, the time required for the growth to commence may be lengthened from minutes to many days. If the density be above 1·25, no growth takes place.

Copper sulphate gives the best results, but it may be replaced by ferrous, manganous, or nickel sulphate; with changes in the shape, and of course in the colour, of the growths. The growths take place most readily from a clean sharp crystal, and always from an angle or edge; an edge obtained by cleavage requires more time. Other salts besides the sulphates may be used, but do not act so rapidly, probably owing to less perfect crystallization of the specimens used.

In a neutral or very feebly alkaline solution the growths are comparatively rapid, and consist of long, branching, tapering fibres, not unlike the roots of a tree. They grow rather more rapidly downwards than upwards. If the solutions be decidedly alkaline, the growths are much slower, and consist of fine stalks with comparatively large lumps at the extremities.

The tubes seem to be composed of silica with a small proportion of the metal used; they differ much in colour, are more dense than the liquid in which they grow, and are insoluble in water or dilute acids. When magnified 100 times, the substance of the tube shows no appearance of crystalline form, but seems to consist of concretions of ovoid granules. In this particular it differs from the substance of lead or silver trees, and from the curious fibres of potassium, iodide, and chloride described by Mr. Warington (J. C. S., v., 136, viii., 31).

It is generally assumed that the formation of onyx is due to the successive deposition of layers of silica coloured by different substances, but the following experiment suggests another possible method of formation, especially when the extreme permeability of gelatinous silica by liquids is remembered. So readily are even the hardest agates permeated by hot aqueous solutions of salts, that "staining" is a common commercial process.

A little too much sulphuric acid was accidentally added to a moderately strong solution of potassium silicate in which some crystals of copper sulphate were lying. The copper sulphate dissolved, and the solution set to a uniform blue jelly. After standing for about a week, the blue colour at the top of the jelly had separated into a series of thin parallel coloured plates, leaving the jelly between them colourless. This curious separation of the colouring-matter gradually proceeded downwards, and reached the bottom of the precipitating glass in about a month. The jelly gradually shrank, dried, and hardened, forming fragments consisting of blue bands in a white mass.

SYDNEY LUPTON.

## NOTES.

THERE will be a memorial celebration for A. W. von Hofmann on November 12, arranged by the Deutsche Chemische Gesellschaft, at Berlin on the 25th anniversary of its foundation. The Empress Frederick and many German and foreign celebrities have been invited to be present. The proceedings, which will take place at the Berlin Town Hall, will include speeches on the history of the Society and on Hofmann, a review of progress in chemical science by Hr. Wislicenus, and choral music, performed by the members of the cathedral choir.

WE regret to have to record the death of Mr. Robert Grant, F.R.S., Professor of Practical Astronomy at the University of Glasgow. He died at Grantown-on-Spey, his native place, at the age of seventy-eight.

THE death of Dr. Löwenherz, director of the Imperial Physical Institute, Berlin, has been announced. He died at Berlin on Sunday last.

PROF. VIRCHOW has been appointed an honorary member of the Imperial Russian Natural Philosophy Society.

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